THE EFFECT OF VARYING DEGREES OF DIFFICULTY OF RETRIEVAL PRACTICE ON LONG TERM MEMORY RETENTION

An Undergraduate Research Scholars Thesis

By

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ABSTRACT

The Effect of Varying Degrees of Difficulty of Retrieval Practice on Long Term Memory Retention. (May 2013)

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Desirable difficulties during the learning process have been shown to enhance learning. In this study we examined how increasing contextual variation boosts memory. Specifically, we investigated how gradually making retrieval practice more difficult by making the background contexts more dissimilar affects overall memory. This will help gauge the effect of context on learning, in order to develop methods to make teaching and studying more effective. Participants viewed face-name pairs, each superimposed on some non-related background image. On retrieval practice (RP) 1, participants were asked to recall each name when the face was again superimposed on the original background scene. Feedback was given afterward. On each subsequent retrieval practice, up to RP5, the background scenes became more unlike the original. The participants were later tested for their overall memory of the names, and their results were compared to two control groups; one group viewed the face-name pairs over the same background for each RP and one group viewed the pairs over completely different backgrounds for each RP. No significant differences were observed between any of the groups in long term memory retention. However, a trend suggests that with more participants a difference will

emerge showing that the control group that viewed the same backgrounds each time experienced greater drops in long-term retention than the other two groups.

NOMENCLATURE

RP	Retrieval Practice

CHAPTER I

INTRODUCTION

One of the main goals in education is to teach students in a way that allows them to effectively learn the given material. . Whereas "acquisition" refers to getting new knowledge into memory, "retention" refers to one's long-term ability to bring knowledge back to mind. More effortful retrieval conditions are known to impede acquisition of new knowledge, but they enhance long-term retention. Underlying effortful learning is the concept of desirable difficulties. These include: spaced repetitions, in which retrieval practice tasks are spread out over a period of time instead of clumped together (e.g. Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006), interleaved practice of contextually interfering tasks, in which subjects are given two or three different tasks and retrieval practice is alternated between each task (e.g. Shea & Morgan, 1979), reduced frequency of feedback, in which feedback is not given after each retrieval practice (e.g. Schmidt, 1991), using tests as learning events, where feedback is not given (e.g. Roediger & Karpicke, 2006), and diminishing cues, where less (i.e. part of the word is cut off) of the target to be recalled is presented with each feedback trial (e.g. Finley, Benjamin, Hays, Bjork, & Kornell, 2011). Contextual variation, in which each retrieval practice task is presented in a different context, also makes retrieval from memory more difficult (Smith & Manzano, 2010). Does gradually reducing the similarity of each retrieval practice context to the original learning context give an even greater enhancement of long-term retention?

CHAPTER II

METHODS

Participants

A total of 55 undergraduates at Texas A&M University participated in this experiment for partial course credit. Participation was voluntary, as other options were available to obtain equal credit. Participants self enrolled in one of three conditions. The number of participants in each session varied from 10 to 15, depending on how many had enrolled. There were 20, 19, and 16 participants in the three conditions.

Design and Materials

Twenty Caucasian male faces were taken from The Psychological Image Collection at Stirling (PICS) (pics.stir.ac.uk) and randomly paired with 20 common names. Each of the names began with a different letter. The face-name pairs were then randomly paired with a background image of some common, nameable place (e.g. bridge, restaurant) obtained from the Internet. Specific recognizable places, such as the White House or Golden Gate Bridge, were avoided.

Three different conditions provided the between subjects independent variable, retrieval practice context. These were the constant context condition, the varied context condition, and the expanding context condition. The dependent measure was performance on the final cued recall test.

Procedure

Participants were tested in groups of 10-15 people, depending on enrollment, in a conference room. They were seated in front of a large screen and instructions were read from a script so they were the same for each group. The participants were told they were being tested on their memory of different face and name pairs. For the encoding task, participants were told simply to watch the video being played. In the encoding video, each face-name pair was shown over the background image for 5 seconds, with a 2 second pause in between subsequent pairs. These stimuli were presented using PowerPoint.

Once the video ended, they were given a packet of 5 sheets of paper, each labeled 1-20. A second video was played with instructions for participants to write down the name with which they thought the face presented was associated. They were told to circle any wrong answers when the feedback was given after the presentation of the face.

The three conditions each had different retrieval practice videos that were shown after the initial encoding. The constant context condition showed the 20 faces, in random order, over the same background image they were paired with in the initial encoding for each of 5 retrieval practices. For example, if a face with the name ‘Andrew’ was first shown superimposed over a bridge, then Andrew’s face would be shown over the same bridge for each of the 5 retrieval practices (Figure 1a). After each 5-second presentation of the face, there was a 2 second pause before feedback, when the names for each face were presented over the same background image. The order of presentation of the face-name pairs was different for each retrieval practice, all of which differed from encoding. This was true for each of the three conditions.

The video for Condition 2, the varied context condition, showed the 20 faces, in random order, over different background images from the encoding background image. The backgrounds were different for each retrieval practice (of 5 RPs), for each face. For example, if Andrew's name and face had originally been shown superimposed over a bridge for encoding, his face may be shown over a soccer field for RP1, a house for RP2, an airport for RP3, and two more different images for RPs 4 and 5 (Figure 1b). After the 5-second interval when the face was shown over the background, there was a 2 second pause before the face and name were presented over the background image that was just shown.

The presentation for Condition 3, the expanding context condition, differed slightly from the first two. For the first RP in this condition, each of the 20 faces were shown over the same background image they had been paired with for encoding (e.g. the inside of a restaurant). For the second RP, each face was shown over a similar, but temporally different image (e.g. the inside of the same restaurant from a different angle). The third RP presented each face over a conceptually similar background to the original encoding background (e.g. the inside of another restaurant). For the fourth and fifth RPs, the faces were presented over completely different backgrounds, neither of which was also used as a background for Condition 2 (Figure 1c). For each retrieval practice, the face was presented over the background for 5 seconds, with a 2 second pause before it was again shown with its paired name, just as for the first two conditions.

For each condition, the appropriate video was played and participants wrote down their answers. After the fifth retrieval practice, the packets were collected and the participants were dismissed for the day. They were reminded to return two days later, at the same time, for the final test.

At test, participants were given a sheet of paper labeled 1-20 and shown the video that presented only the faces they had studied, without any background images. Participants in each condition were shown the same video. This video, again created using PowerPoint, showed each of the faces for 5 seconds over a plain white background. None of the background images from the encoding or retrieval practice were seen in the test. There was a 2 second pause on a blank screen before the next face was presented. The faces were, once again, in a random order that differed from that of either the encoding or any of the retrieval practices. Participants were told to write down the names that had been paired with those faces. The papers were then collected and the participants were dismissed.

Figure 1. Example of how the constant, varied, and expanding context conditions might see the same face for each practice trial.

CHAPTER III

RESULTS

Two types of analyses were conducted: analyses of acquisition effects (i.e., performance on each of the five RP trials), and analyses of retention effects (i.e., performance on the final test, which was given with no contexts in the background). Acquisition scores were analyzed with a 3 (context condition, a between-subjects variable: constant, varied, or expanding) X 5 (retrieval practice trial, a repeated measure) analysis of variance (ANOVA), and pairwise comparisons at each level of retrieval practice were done as planned comparisons. Retention scores were analyzed in two ways, once using recall as the dependent measure, and a second using forgetting (number recalled at RP5 minus number recalled on the final test) as a measure. Each was analyzed with a 1-way ANOVA, using context (constant, varied, or expanding) as a between-subjects factor, followed by planned comparisons among the three conditions.

The ANOVAs showed that participants in each of the conditions performed equally well in RP5 ($F=3.00$, $p=0.058$) and in the final test ($F= .268$, $p=0.766$) (Table 1). However, prior to RP5, the participants in the constant context condition performed better than those in the varied context condition, as shown by Tukey's test. The post hoc tests also showed that the proportion of words remembered in the expanding context condition was not different from that of the varied context condition in RP1 or RP4. In addition, the number of words recalled by participants in the expanding context condition was the same as that recalled by participants in the constant context condition in RP2 and RP3 (Table 2).

Table 1. ANOVAs for each condition by each RP

		Sum of Squares	df	Mean Square	F	Sig.
RP1	Between Groups	.135	2	.067	4.281	.019
	Within Groups	.817	52	.016		
	Total	.952	54			
RP2	Between Groups	.777	2	.389	11.032	.000
	Within Groups	1.832	52	.035		
	Total	2.609	54			
RP3	Between Groups	.488	2	.244	7.334	.002
	Within Groups	1.731	52	.033		
	Total	2.219	54			
RP4	Between Groups	.465	2	.233	7.931	.001
	Within Groups	1.525	52	.029		
	Total	1.990	54			
RP5	Between Groups	.152	2	.076	3.000	.058
	Within Groups	1.321	52	.025		
	Total	1.473	54			
Final	Between Groups	.019	2	.009	.268	.766
	Within Groups	1.806	52	.035		
	Total	1.825	54			
RP5FinalDiff	Between Groups	.084	2	.042	2.689	.077
	Within Groups	.810	52	.016		
	Total	.894	54			

*Final indicates performance on the final test.
*RP5FinalDiff indicates the difference between performance on RP5 and the final test.

Table 2. Tukey's Post Hoc Tests for RP1-RP4

RP1

Tukey B[a,b]

Condition	N	Subset for alpha = 0.05	
		1	2
Varied	20	.1500	
Expanding	16	.1594	
Constant	19		.2579

RP2

Tukey B[a,b]

Condition	N	Subset for alpha = 0.05	
		1	2
Varied	20	.2775	
Expanding	16		.5156
Constant	19		.5316

RP3

Tukey B[a,b]

Condition	N	Subset for alpha = 0.05	
		1	2
Varied	20	.5500	
Expanding	16		.7406
Constant	19		.7500

RP4

Tukey B[a,b]

Condition	N	Subset for alpha = 0.05	
		1	2
Expanding	16	.6750	
Varied	20	.6900	
Constant	19		.8763

CHAPTER IV

CONCLUSION

Discussion

As predicted by previous experiments (Smith, Handy, Nichols, & Angello, 2012), acquisition was faster for participants in the constant context condition than for those in the varied context condition. Interestingly, both groups showed similar retention rates on the final test. In addition, no significant difference was found between the forgetting rates for the two groups. Previous experiments in the lab had shown a crossover at the final test: participants in the varied context condition remembered almost every name they had known by RP5, whereas participants in the constant context condition, who had known almost every name, remembered significantly less names at final testing than those in the varied context condition. In the previous experiment, however, the contexts used were videos instead of pictures. The videos may have been a more salient background due to the fact that some of them had sound in addition to movement. Still images as background contexts may have been easier to ignore, leading to easier acquisition for the participants in the varied context condition and greater retention on the final test for participants in the constant context condition.

The participants in the expanding context condition also showed some interesting behavior. As shown in Figure 2, participants in this condition showed roughly the same rate of acquisition as participants in the constant context condition through RP3. At RP4, the background images became completely different in the expanding context condition. Whereas previous background images had been somewhat similar, those in RP4 and RP5 were the same backgrounds that

participants in the varied context condition saw. Interestingly, it was at this point in the experiment that expanding context participants did not seem to learn anything new for one trial. After RP4, they continued to improve with the varied context participants. This showed that there was some reliance on the contexts, but not enough to significantly hinder performance.

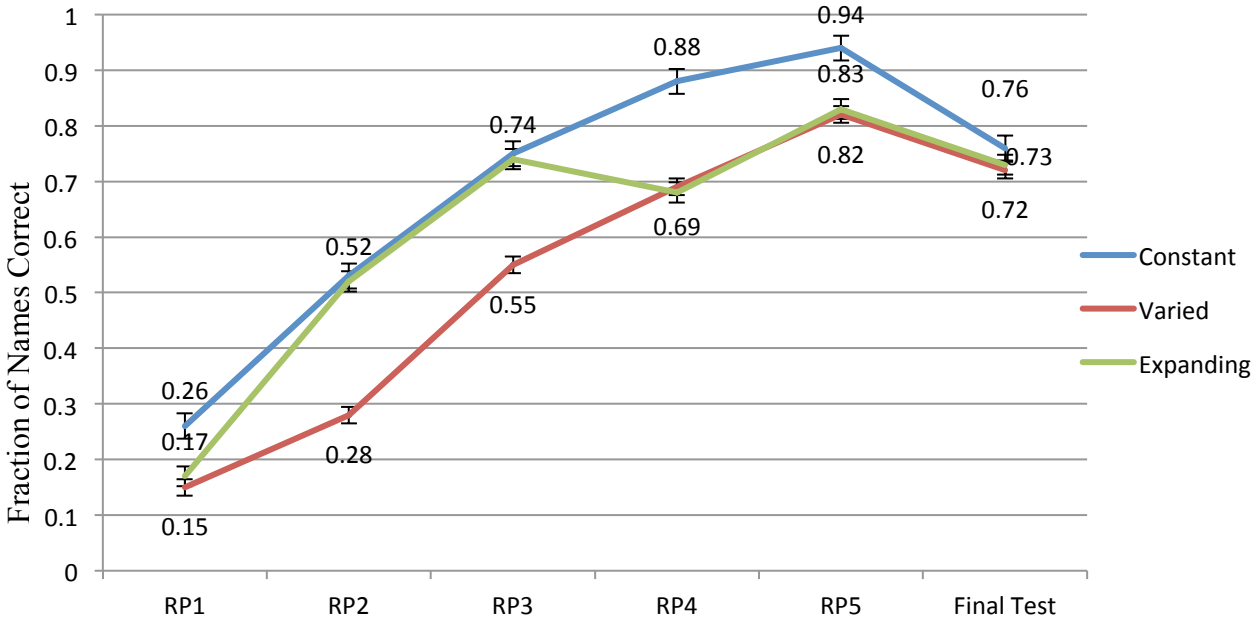

Figure 2. Acquisition and retention rates for all conditions.

On RP5, there was not a significant difference in the number of learned names between the three conditions. However, Figure 2 shows a trend toward constant context yielding greater recall, which is substantiated by a p value of .058. This suggests that with more participants, this difference could become significant. In addition, there was not a significant difference between the forgetting rates of the three conditions. However, there seems to be a trend here too, with the constant condition participants forgetting about 20% of the names, while participants in the varied and expanding context conditions only forgot about 10%. Since this was an exploratory study, these initial findings will be critically tested in subsequent experiments.

Final Conclusion

Background context is an important factor in acquisition of new material. With still images as contexts, this effect seems to level out after a few learning trials. Gradually reducing the similarity of the context to the original also appears to affect learning by making acquisition faster. Further investigation with more participants will need to take place to see if different background contexts actually yield significant differences in long-term retention.

REFERENCES

Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. Psychological bulletin, 132(3), 354.

Finley, J. R., Benjamin, A. S., Hays, M. J., Bjork, R. A., & Kornell, N. (2011). Benefits of accumulating versus diminishing cues in recall. Journal of memory and language, 64(4), 289-298.

Roediger III, H. L., & Karpicke, J. D. (2006). Test-Enhanced Learning Taking Memory Tests Improves Long-Term Retention. Psychological Science, 17(3), 249-255.

Schmidt, R. A. (1991). Frequent augmented feedback can degrade learning: Evidence and interpretations. Tutorials in motor neuroscience, 59-75.

Shea, J. B., & Morgan, R. L. (1979). Contextual interference effects on the acquisition, retention, and transfer of a motor skill. Journal of Experimental Psychology: Human Learning and Memory, 5(2), 179.

Smith, S.M., Handy, J.D., Nichols, J.H., & Angello, G. (2012). Training wheels and desirable difficulties: Effects of contextual constancy and variation on acquisition and retention. Paper presented at the Annual Meeting of the Psychonomic Society, Minneapolis, MN.

Smith, S. M., & Manzano, I. (2010). Video context-dependent recall. Behavior research methods, 42(1), 292-301.